

General Atmospheric Pollution

Los Angeles "Smog" *

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ON winter mornings when most air pollution control officials are especially busy controlling smoke, soot, and fly ash from overloaded heating plants, Los Angeles residents can usually see distant snow-capped "Old Baldy" mountain with sparkling clarity. On the other hand, air pollution conditions on many summer and fall mornings have caused "smog" stories to become favorites of Hollywood radio comedians. The need for cleaning the air has become a major public issue. Office and industrial workers frequently find a disappointing contrast between high, clear and sunny mornings in residential areas and the hazy, irritating, burned-petroleum-scented blanket accumulated in the business and industrial section of the Los Angeles River basin.

Although this peculiar condition had existed for a number of years and was reported by the press in 1940, it did not become acute until July, 1943, when the haze and irritants were noticeable between 8:00 a.m. and 12:00 noon on several days. On July 26 they became so acute that most people in the affected area were using handkerchiefs to wipe tears from red, smarting eyes. Every telephone in the Health Department was busy answering complainants. On that morning smoke from a heavy freight train produced a black cloud that hung

near the ground, was several hundred feet wide, and extended for several miles. Smoke from chimneys spread out and formed a black cloud that extended for more than a mile from their source. According to the weather bureau the wind velocity was less than 2 miles per hour. A further examination of the records of the weather bureau, for days when air contaminant accumulations were heavy, failed to show any direct correlation between smog accumulations and humidity or recorded wind directions.

We assigned sanitarians to strategic vantage points while others drove across and observed the affected metropolitan area. These observations and information received from complainants showed that the hazy accumulation seemed to descend on the entire area, approximately 10 miles in diameter, within a period of not more than 15 minutes. On each of the mornings the air was perfectly clear until about 8 o'clock and was hazy by 8:15. On one morning, from the City Hall tower, we could clearly see the mountains 20 or more miles away but could barely see cars on the street below. We looked down on a level lake of dark grey haze.

Meteorologists pointed out that the upper surface of this haze was actually the base of a marked "temperature inversion." On clear, calm nights the ground heat is lost by radiation and cold air drains from surrounding mountains to the river basin. Direct and reflected rays of the morning sun warm

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the upper air causing the temperature at an elevation of 1,000 feet to be as much as 30° warmer than near the ground. This temperature inversion acted almost the same as a roof over the city, preventing contaminants from escaping to the upper air. This condition, coupled with the very low horizontal air movement and lack of turbulence, caused all contaminants to be accumulated in the vicinity where generated.

With conditions so unfavorable to the dispersion of smoke we believe our control measures must eliminate even those sources of air pollution not significant in most communities. We have no coal-burning furnaces or boilers, and nuisance conditions occur only on warm days when heating plants are not operated. During such periods many industrial boilers are operated on gas available at "off peak demand" rates.

We made a number of airplane and blimp observation trips over the entire metropolitan area. Certain specific sources of visible smoke and contaminants were readily apparent. These included refineries located near the ocean shore approximately 20 miles from the affected metropolitan area. Smelters, chemical plants, packing plants, and oil-burning boilers in a large industrial area located east of and within 2 miles of the metropolitan area were heavy contributors to the visible smoke. Oil-burning steam railroad engines, particularly switch engines, caused a huge amount of dense, black smoke. The burning of combustible refuse of all kinds in backyard incinerators, at commercial and industrial establishments and at public dumps was producing heavy accumulations of grey and black smoke. Major highways and traffic arteries, particularly those heavily traveled by smoking Diesel trucks, produced long bands of smoky haze accumulations.

Control of visible smoke was our first goal. Simultaneously we began studies to determine the chemical na-

ture and sources of the irritants. At the request of the Health Officer, Mayor Fletcher Bowron made personal appeals for assistance to the U.S. Public Health Service and other federal agencies. He tried to encourage a local university to undertake a combination meteorological and chemical study, and the Los Angeles County Board of Supervisors agreed to pay the entire cost of the investigations and research. None of these agencies agreed to undertake the project.

Both the city and county health departments established Bureaus of Air Pollution Control and these worked together in developing identical ordinances and uniform programs. The Board of Supervisors agreed to provide free control services to the 40 or more incorporated cities in the county but few accepted the offer. Unless an incorporated community adopted the regulations, neither Los Angeles City nor the county had any legal right to effect control in that area.

Even with large, uncontrolled industrial communities continuing their discharge of air pollutants, a marked improvement has been accomplished. Joint City-County Smoke Abatement Hearing Boards, working with railroad officials and representatives of the Brotherhoods, have nearly eliminated railroad smoke. This is being accomplished by hearing cases presented by railroad smoke specialists of the departments, after which the railroad officials find and eliminate the cause. When it was decided it was impossible to eliminate smoke from steam switch engines, the railroads substituted Diesel power.

Truck owners and the drivers' union are represented on the Diesel (truck) Smoke Control Hearing Board. The city Diesel truck specialist has encouraged installation of a number of dynamometers for adjusting fuel injectors for maximum efficiency and smokeless operation under various load conditions. H. E. Kunkel, the Air Pollution

Control Director, conducts regular classes in smoke observation for city traffic officers. These officers cite violators to the Hearing Board. Mechanical adjustments of the offending engine, or improved operation by the drivers, have almost eliminated the former common clouds of black truck smoke. Articles and pictures by our Diesel specialist have appeared in the truck drivers' and owners' magazine. A major oil company has made an excellent colored moving picture on smokeless operation of Diesel trucks.

Industry has been exceedingly coöperative. The Chamber of Commerce has for several years held bi-weekly meetings of its Committee on Air Purification. Technical consultants from the petroleum industry have been most helpful in correcting smoke from oil burning boilers. Refineries have spent hundreds of thousands of dollars in abatement equipment. Lumber, paint and varnish manufacturers, smelters and other industries are doing extensive research. While a number of court cases were necessary, most accomplishments have been on a coöperative basis.

Funds have been made available for construction of a number of public incinerators. Plans are being formulated for public collection of combustible refuse to eliminate the several hundred thousand smoke-producing back-yard incinerators.

Preliminary information indicates that a major reduction in visible smoke has already been accomplished. During the year 1943, electrostatic precipitator samples gathered on days when irritants were particularly noticeable showed a concentration of particulate matter ranging from 15 to 42 mg. per 10 cu. m. During the year 1947 similar samples showed a maximum concentration of 7 mg. per 10 cu. m., or a reduction of from 100 to 600 per cent. Visual observations also indicate a remarkable reduction in the amount of man-made haze,

although much remains to be accomplished in this regard.

Naturally one of our first objectives was to locate and identify the eye-irritating chemicals. Industrial type hygiene sampling investigations made by the city and county failed to reveal any one common lachrymator in quantities sufficient to be considered responsible for the eye irritation. The County Health Department also arranged for analyses of mass spectograph samples collected in various ways including freezing with liquid nitrogen, but so far no conclusive results can be reported. The two chemicals present in the air in significant amounts are sulfur dioxide and aldehydes. Both serve as rather accurate indices of the eye irritant condition since whenever eye irritation is noted the concentration of these chemicals is high. Sulfur dioxide, however, has never been found in amounts greater than 0.6 p.p.m. This is several hundred per cent lower than is regularly found in certain eastern and midwestern coal burning communities where eye irritation is not a problem. The maximum aldehyde concentration was also 0.6 p.p.m., an amount insufficient to account for the irritation.

There is some indication that exhaust from internal combustion engines is a major contributor. Tests made in an improperly ventilated tunnel during heavy traffic indicate heavy concentrations of aldehydes and marked eye irritation at times when the outside air is clear. Tests of car, truck, and bus exhausts show that the discharge of aldehydes is high when the engine is decelerating. The general odor present during days of eye irritation is similar to the discharge from automotive buses and the irritating effects of both are similar. Because of this it is difficult to predict with any assurance that the control of industrial and railroad smoke will eliminate the eye irritation. Further studies need to be made on the effect of automotive ex-

haust and possibly some control measures will be necessary.

The county arranged for certain limited studies by two local universities. Results of the chemical and physiological studies have not been officially announced, but they are not conclusive. Meteorological studies substantiate our earlier observations on the effects of weather conditions on air pollution.

Recently we made the first of a series of airplane observation flights which we hope will shed further light on the major sources of visible haze. This is a volunteer project of the National Guard Air Unit, which is justified because reduced visibility, caused by man-made haze, is a definite flight hazard.

Under stimulation and public support developed by an active program of the *Los Angeles Times*, the last session of the California Legislature adopted a law permitting formation of County Air Pollution Control Districts with authority for enforcing regulations in all sections of a county. There is now being formed a Los Angeles County Air Pollution Control District. Unfortunately, because the former County Health Officer was anxious to be relieved of the responsibility for air pollution control, the new law provides that the districts shall be separate from the Health Department. While the City of Los Angeles is a part of this smoke district, the Mayor and Council have appropriated funds for continuing the city's Bureau of Air Pollution Control within the Health Department. We have felt that air pollution control is definitely a part of our sanitation program; that we cannot properly refer complaints about odors, smoke, and other nuisances to another agency; that our district sanitarians can take care of many of the

minor complaints about air pollution, referring to the specialist only those more involved problems that require technical guidance. We shall look to the County Bureau for the major research and will cooperate with them in that as well as in the entire enforcement program.

SUMMARY

Los Angeles experiences, on certain summer and fall mornings, heavy accumulations of types of air contaminants causing serious smarting of the eyes. This accumulation is due to a low and marked temperature inversion accompanied by extremely light winds or total absence of horizontal air movement. The actual sources of the irritants have not been discovered, but a program has been inaugurated for eliminating all sources of visible air pollution. Due to the large number of complex chemicals that could be produced by incomplete combustion of petroleum products we have not been able to identify the irritant. There is some possibility that the chemicals in the air are different from those leaving the sources. The effect of hydrolysis, oxidation, catalytic action of sunlight, and other factors must be considered. To isolate and identify the chemical is a complex problem. Meteorological investigations and regular airplane observations will be continued in the hope of gaining more definite knowledge of the location of the major pollutant sources.

Our experience indicates that health department, engineering, and industrial hygiene bureaus, working together, form a logical team for air pollution control; and that air pollution control should be accepted as a health department responsibility.